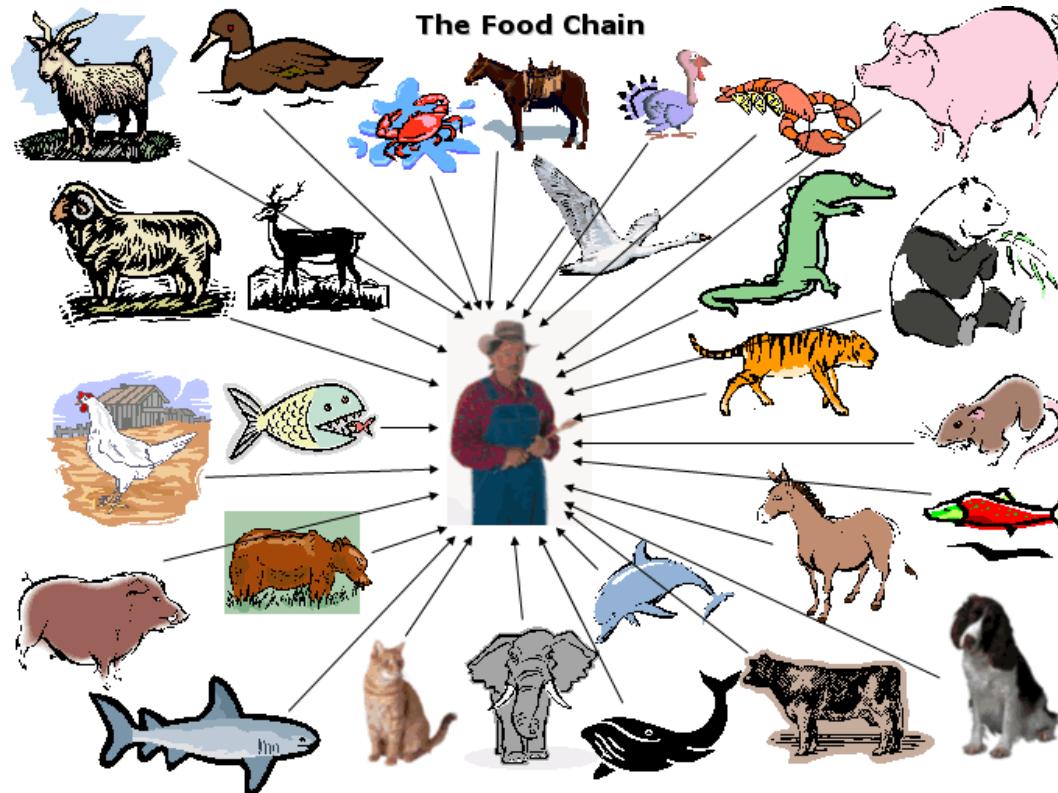


Herps in Ecosystems



Competition

- Types of competition
- Competition and the niche
- Competitive exclusion principle
- Character displacement
- The problem with competition

Competition

- Types of competition
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Competition

- An interaction between two (or more) species where each has a negative effect on the fitness of the other
- Examples:
 - Geckos competing for insect prey items
 - Painted turtles competing for basking sites

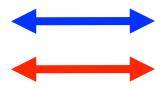


Painted turtles (*Chrysemys picta*)

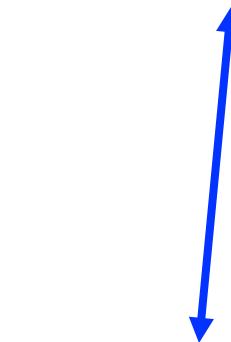
Competition

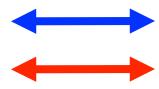
- Competition can occur both within species (intraspecific competition) and between species (interspecific competition)
- Both are important in ecological and evolutionary theory



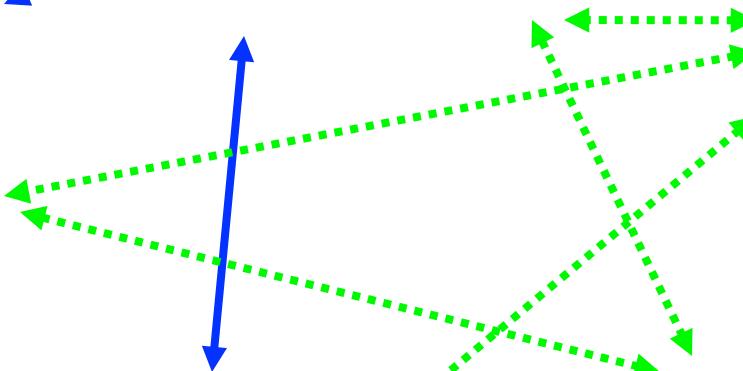


Intraspecific competition





Intraspecific competition



Interspecific competition

Competition and Coexistence

- All else being equal, species will coexist if interspecific competition is weaker than intraspecific competition
- This will allow species to increase when rare and prevent competitive exclusion

Main Types of Competition

- Interference competition
 - Direct mechanism of competition where individuals interact aggressively with each other
 - Example: territorial defense



Photos by Dennis Hansen

Main Types of Competition

- Interference competition
 - Direct mechanism of competition where individuals interact aggressively with each other
 - Example: territorial defense
- Exploitation competition:
 - Indirect mechanism of competition where individuals affect each other through their use of a limiting resource
 - Example: invertebrate feeding by terrestrial salamanders



Mandarin Salamander, *Tylototriton verrucosus*, eating a worm

Main Types of Competition

- Both of these types can be either intra- or interspecific
- Examples:
 - Two brown anoles aggressively fight over a perch site

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Main Types of Competition

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 - Two brown anoles aggressively fight over a perch site
 - *intraspecific interference competition*
 - A painted turtle and a map turtle indirectly compete for food in a small pond
 - *Interspecific exploitation competition*

Competition

- Types of competition
- Competition and the niche
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- The problem with competition

Aspects of the Herp Niche

- Temporal niche - what time of day is the species active?



Greg Calvert (C)

Aspects of the Herp Niche

- Spatial niche - where do they live?



Aspects of the Herp Niche

- Trophic niche - what do they eat?



Aspects of the Herp Niche

- Predatory niche - How do they escape predators?



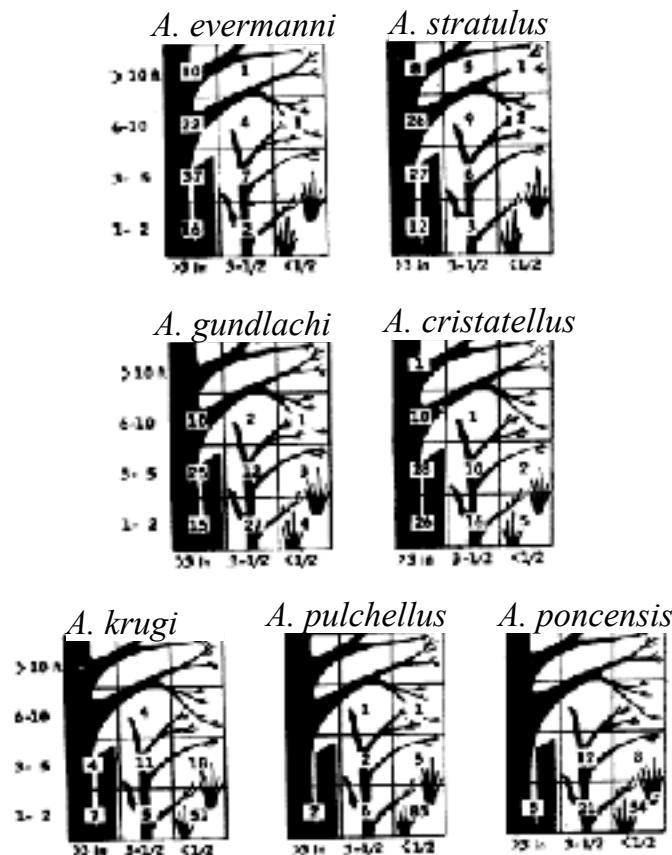
Competition

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Competition Matters

- **Gauss's competitive exclusion principle** states that two species competing for exactly the same resources cannot coexist
 - Two species in the same place cannot have the same niche
 - One will eventually outcompete the other

Niche Partitioning in *Anolis*

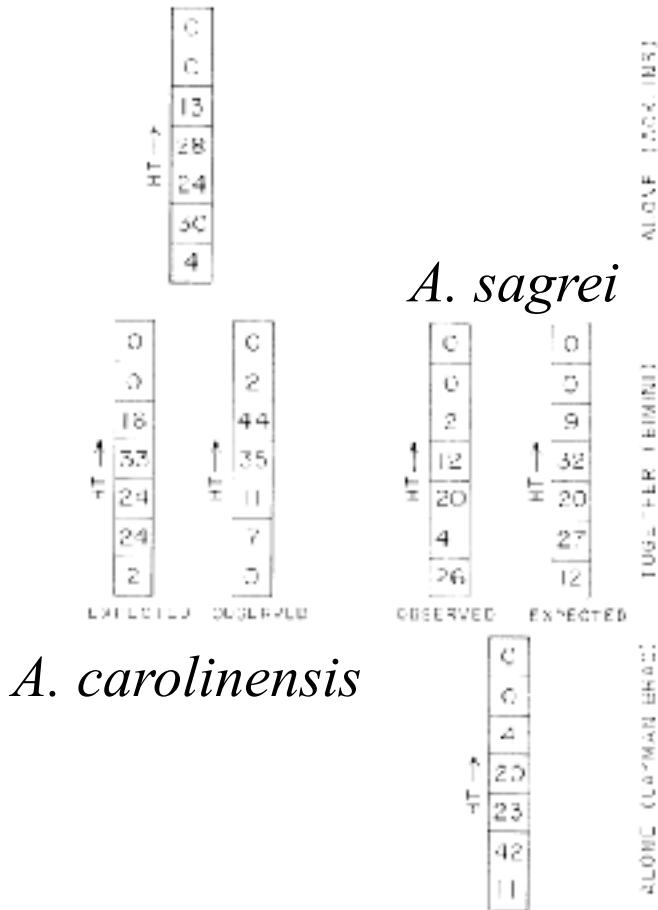


- Sympatric species of anoles use different microhabitats
- Perch height
- Perch diameter

(Rand 1964)

Habitat Shifts in *Anolis*

- Species shift their microhabitat use to become more different in sympatry compared to allopatry



(Schoener 1975)

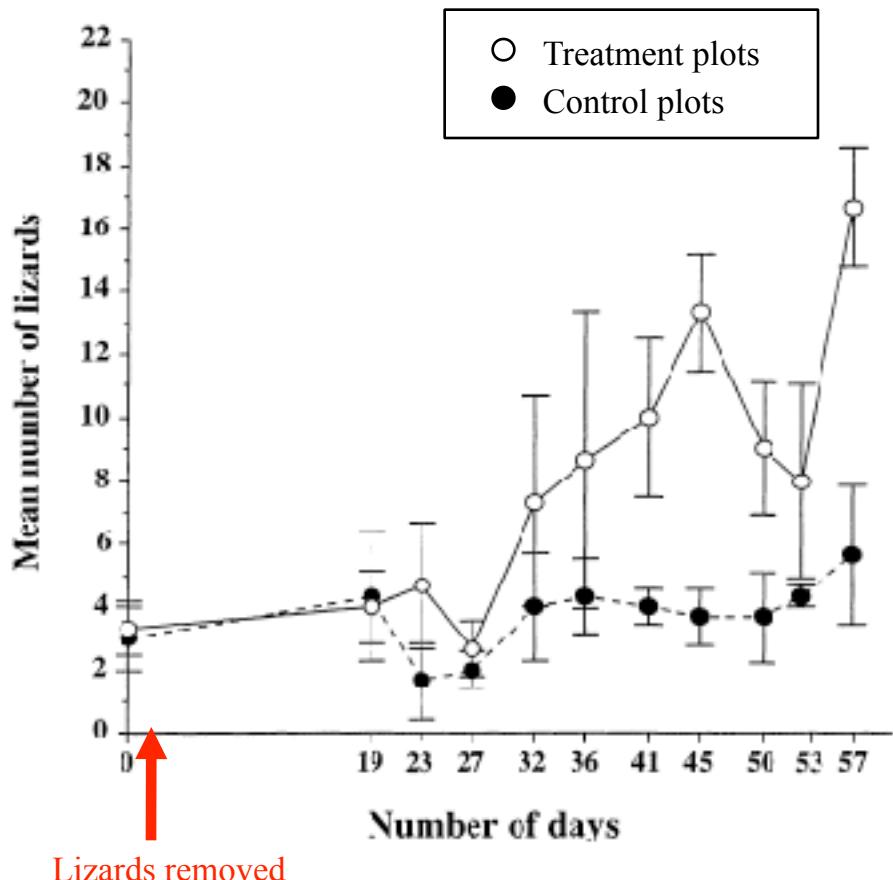
Sympatric Species Compete in *Anolis*

- Experiments offer more definitive evidence for competition

In anoles, competition affects:

- Abundance
Leal et al. 1998
- Microhabitat use and diet

Pacala and Roughgarden 1982
Roughgarden et al. 1984
Pacala 1985



Leal et al. 1998

Competition

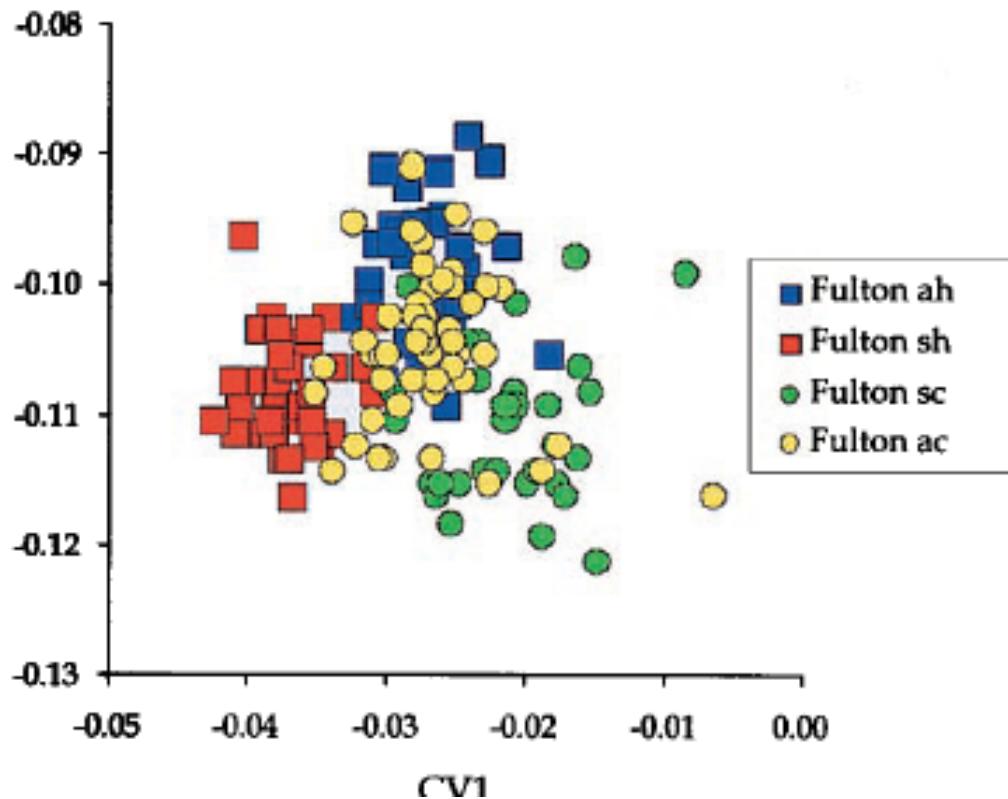
- Types of competition
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Character Displacement

- Habitat shifts in sympatry may lead to divergent selection between the two species
- They may evolve phenotypic differences in sympatry
- This is called character displacement

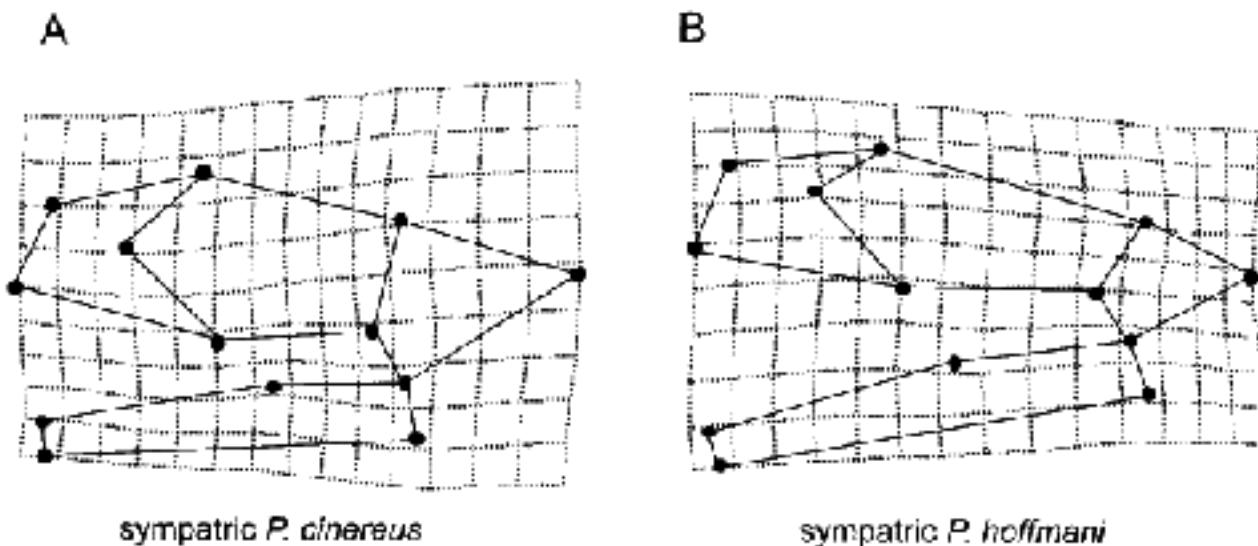
Character Displacement in Salamanders

B



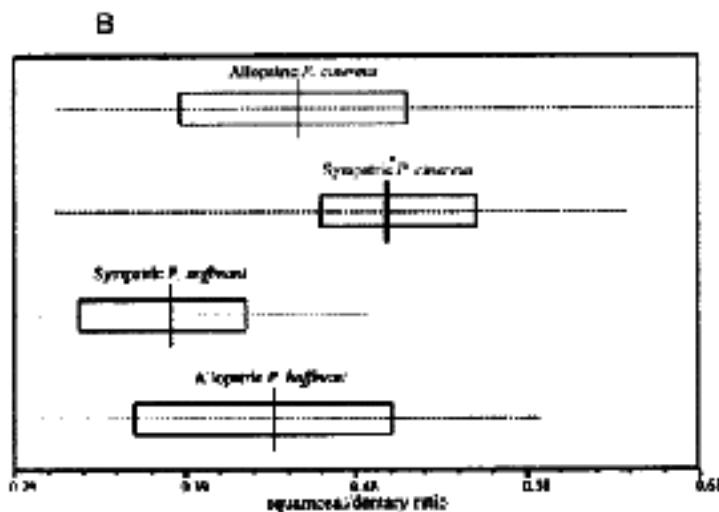
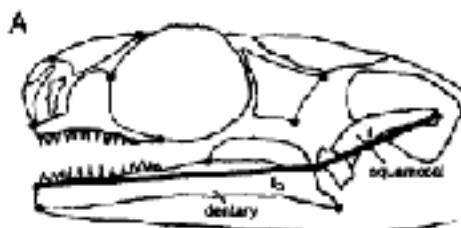
Species differ,
but only in
sympathy

Character Displacement in Salamanders



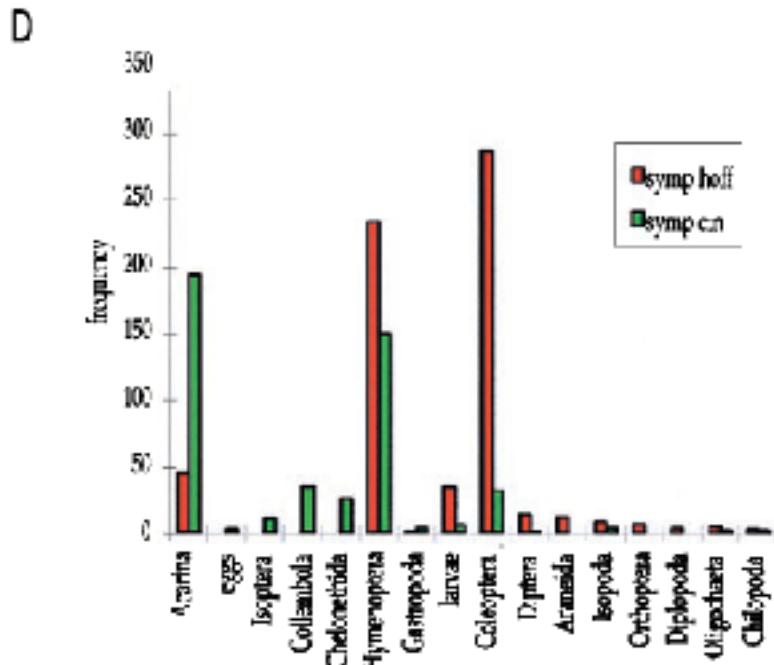
Sympatric species have different head shape...

Character Displacement in Salamanders



Sympatric species have different bite force...

Character Displacement in Salamanders



Sympatric species have different diet

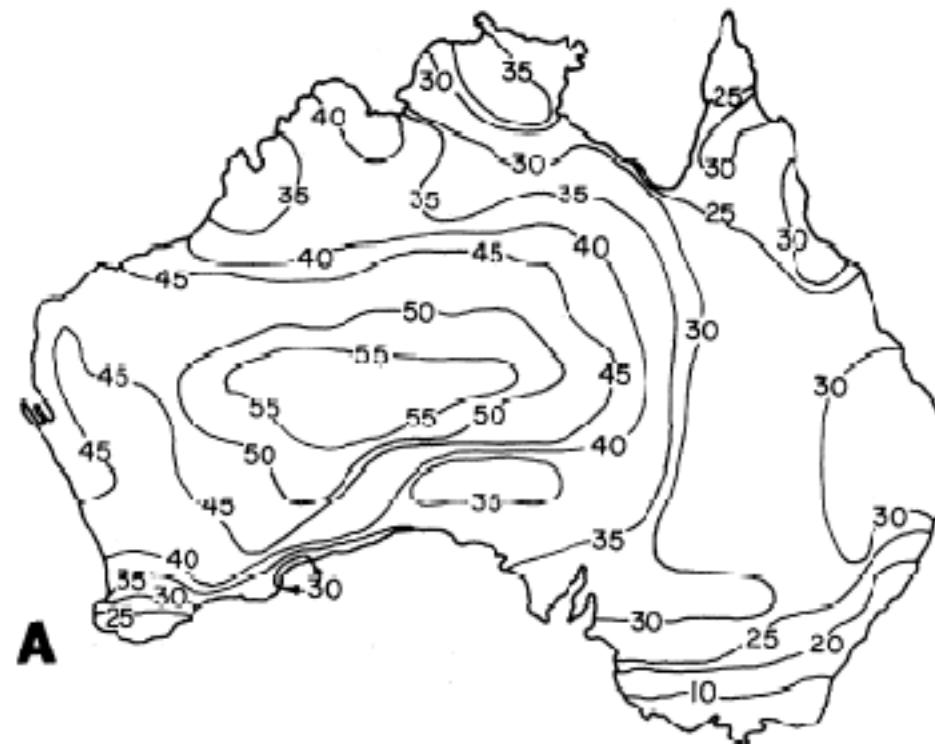
Competition

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The problem with competition

- The competitive exclusion principle is not testable in practice
- All species differ in some way, if you measure enough
- There are other ways to get species to live together - to infinity!
- Examples of exclusion are rare, even in invasive species

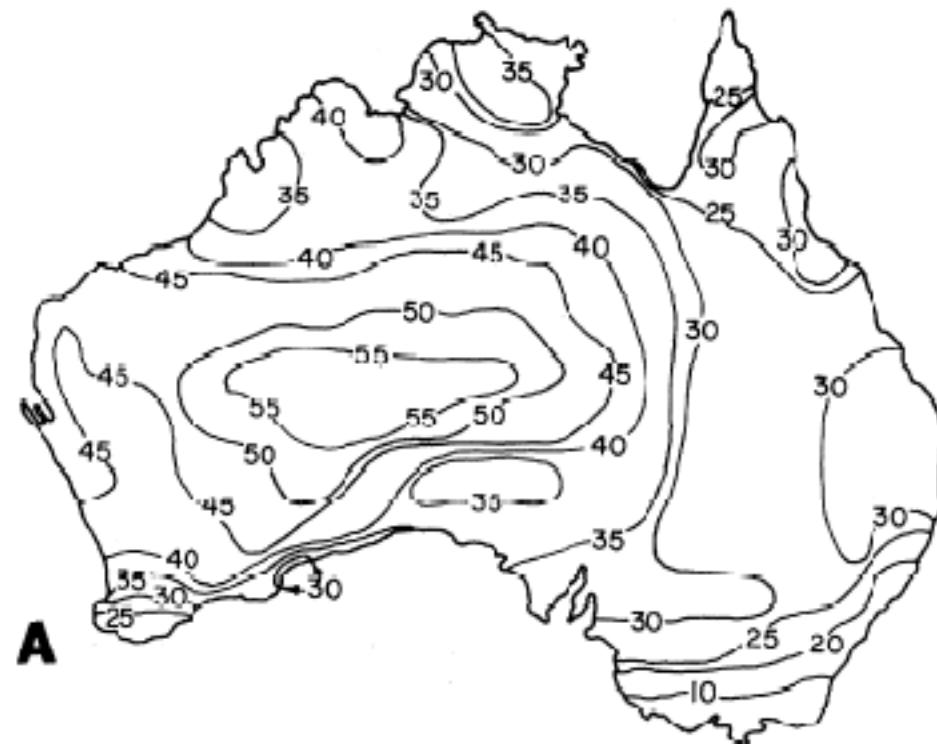
Why are there so many species?



Species Diversity of Nonskink Lizards in Australia

(Schall & Pianka 1978)

Why are there so FEW species?



Species Diversity of Nonskink Lizards in Australia

(Schall & Pianka 1978)

Modern Community Ecology

- Modern community ecology seeks to integrate all of these ideas
- Species interact through competition, but the magnitude may be weak, and vary through space and time
- Models can predict any number of species - so why do we get the exact number that we see in nature?

Herps in the food web

- Predation - why is it important?
- How do herps avoid predators?

Some herp predators



Invertebrates



Other herps



Birds



Mammals

Why is predation important?



Secretary bird
Sagittarius serpentarius



Striped Skink
Mabuya striata

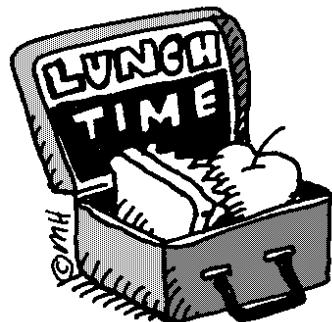
Why is predation important?



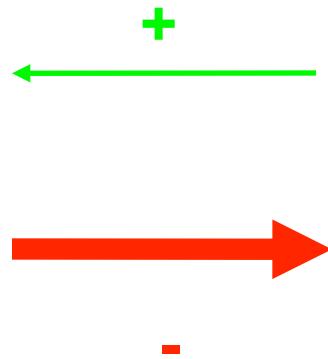
Secretary bird
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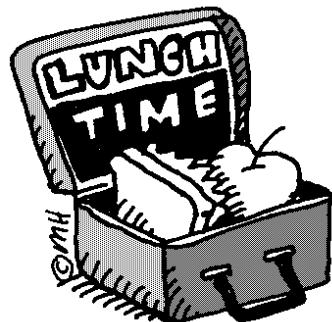


Why is predation important?



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Sagittarius serpentarius

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The “life-dinner” principle

- Interactions between predators and prey are frequently asymmetric
- Predator gains or loses a meal
- Prey gains or loses its life
- Selection for antipredator defense mechanisms can be strong

Defense mechanisms

- Avoid detection
- Avoid capture
- Avoid consumption
- Signal inedibility (or mimic)



Defense mechanisms

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Avoid detection

- Crypsis is common in herps
- Resemblance can be general or specific
- Example: green lizards are usually arboreal



Avoid detection

- Crypsis is common in herps
- Resemblance can be general or specific
- Example: green lizards are usually arboreal
- Green and grey Pacific tree frogs (*Pseudacris regilla*) will move to places where they match the substrate



Phrynosoma modestum, round-tailed horned lizard



Uroplatus sikorae
Mossy leaf-tailed gecko



Eyelash Leaf Frog *Ceratobatrachus guentheri*

Avoid detection

- Moderate behavior in the presence of predators - be quiet, hide, etc.
- This may have a cost
- Less food or mates
- Organisms have to balance costs and benefits

Example: Túngara frog



Physalaemus pustulosus

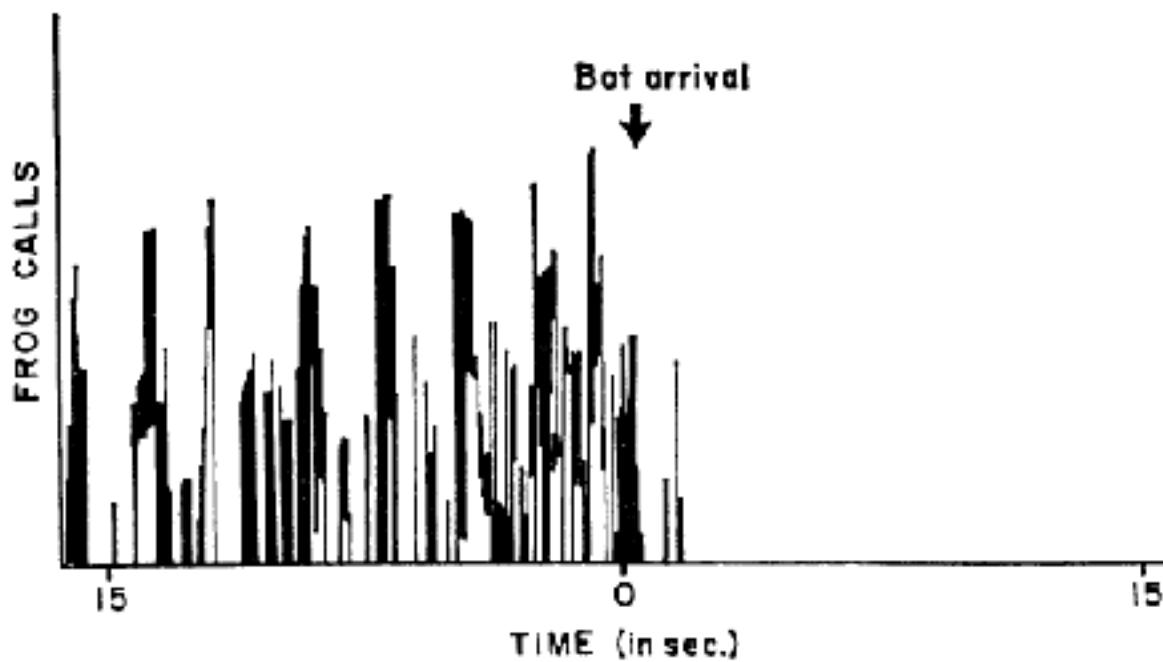
Example: Túngara frog



Fringe-lipped bat
Trachops cirrhosus



Example: Túngara frog



Defense mechanisms

- Avoid detection
- **Avoid capture**
- Avoid consumption
- Signal inedibility (or mimic)



Avoid Capture

- Run away



Zebra-tailed lizard, *Callisaurus draconoides*, 4 m/s (about 9 mph)

Avoid Capture

- Glide



Draco maculatus



8:29:42 AM



8:29:42 AM

Avoid Capture

- Confuse

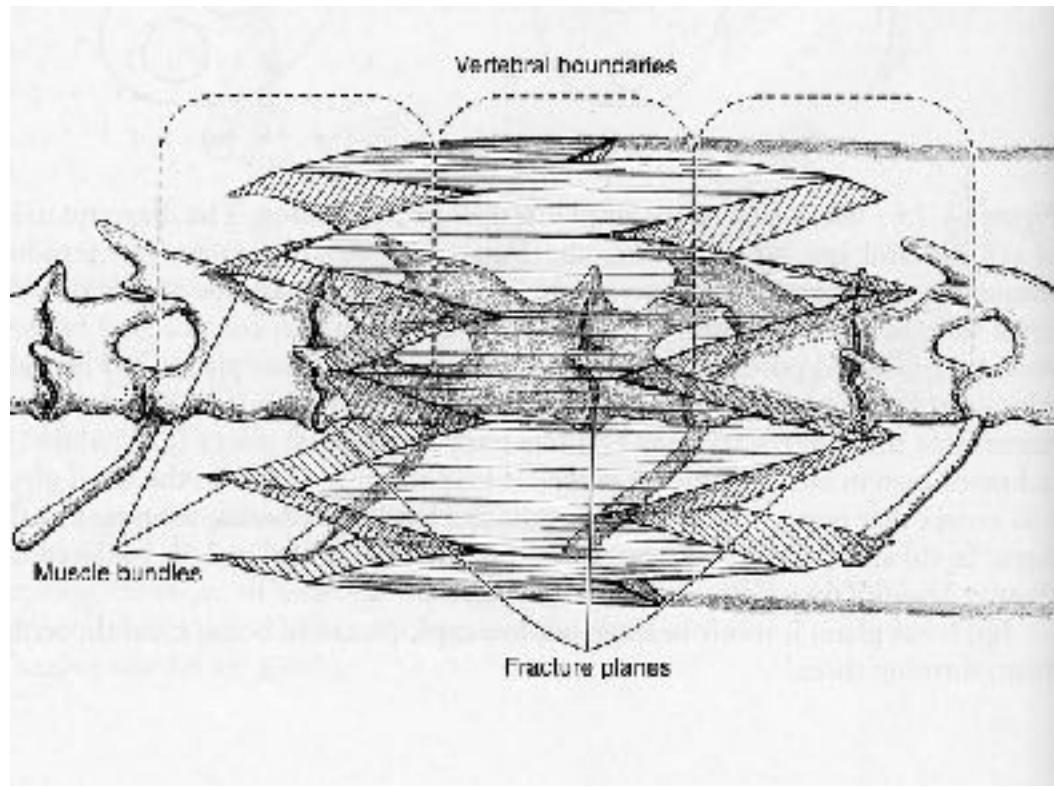




Uroplatus fimbriatus



Caudal autotomy



Avoid capture

- Flee (run, jump, glide, swim...)
- Confuse
- Threaten
- Drop your tail



Defense mechanisms

- Avoid detection
- Avoid capture
- **Avoid consumption**
- Signal inedibility (or mimic)

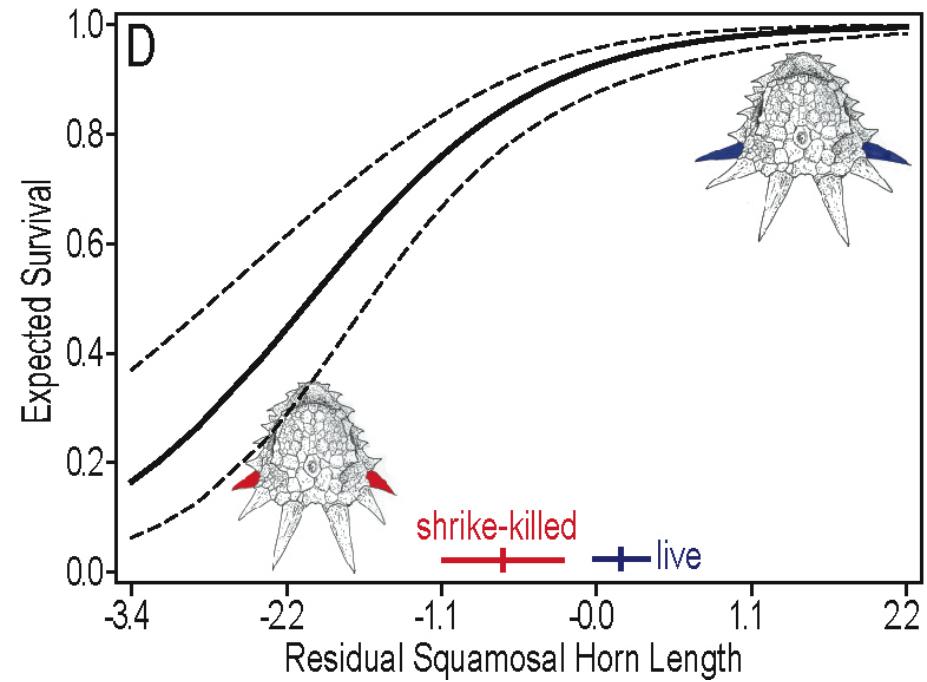
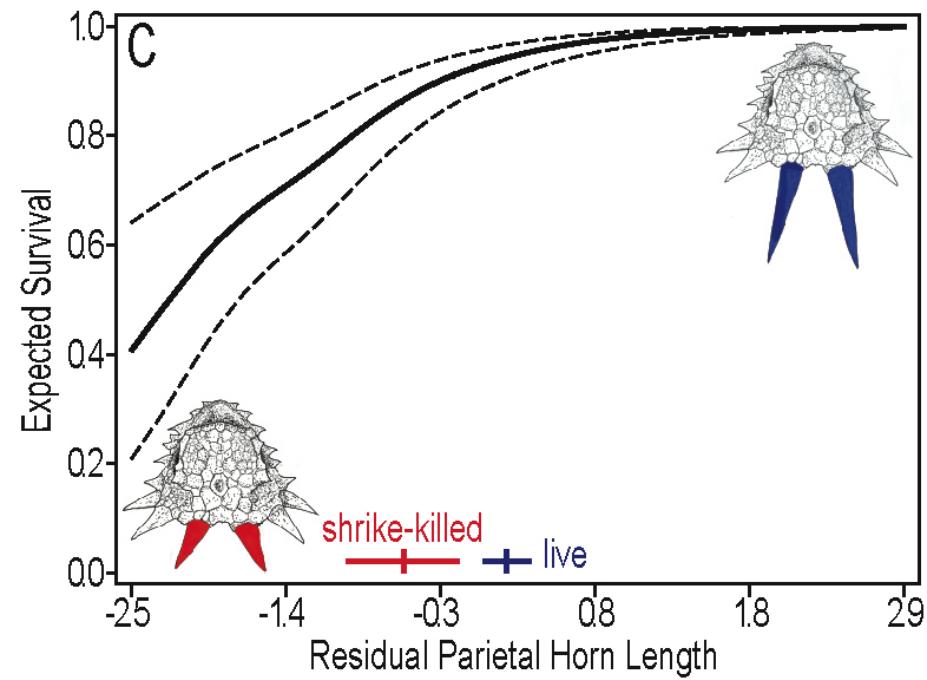








Phrynosoma mcallii



Toxicity

- Many amphibians use toxicity as a defense
- Dart poison frogs (*Phyllobates*), bufonids (*Atelopus*), newts (*Salamandra*, *Notophthalmus*, *Taricha*)



Toad (*Atelopus spumarius*)

Taricha and TTX

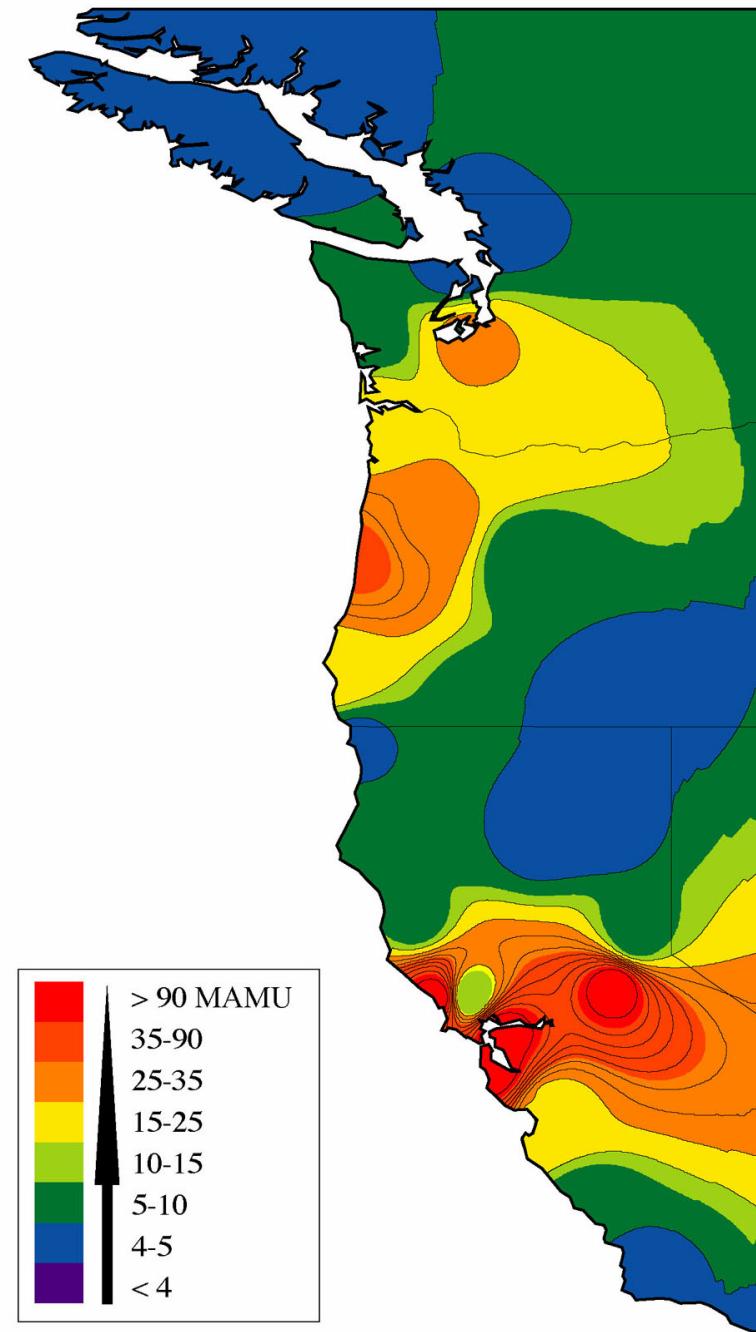
- *Taricha granulosa* (rough-skinned newt) has tetrodotoxin (TTX) in skin
- One newt has enough to kill 25,000 rats



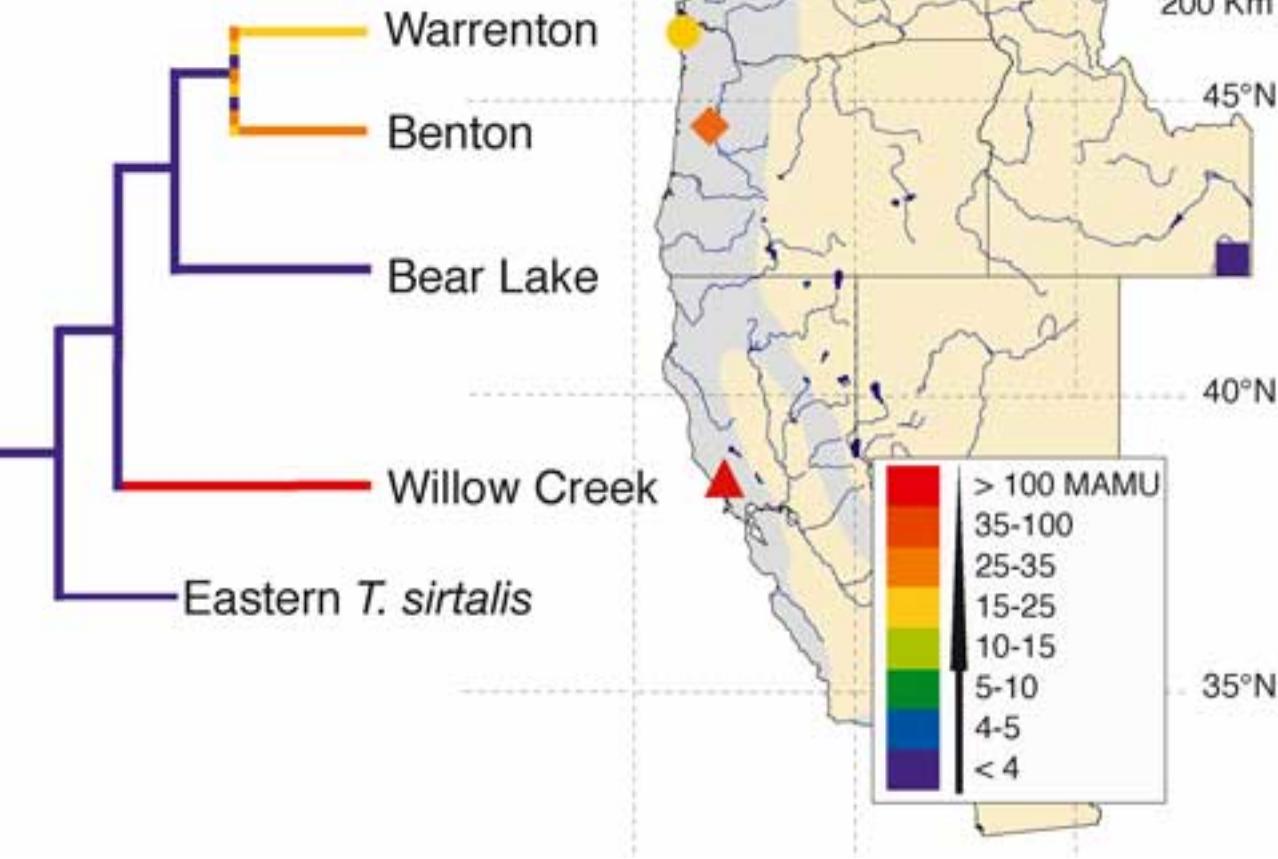


© Edmund D. Brodie III

- Garter snake (*Thamnophis sirtalis*) feeding on *Taricha*



- Newt toxicity varies from place to place



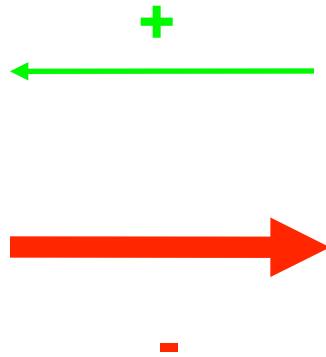
- Garter snake resistance parallels newt toxicity

Defense mechanisms

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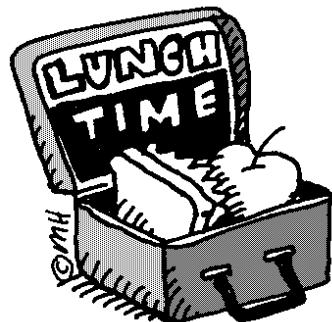


Why is predation important?

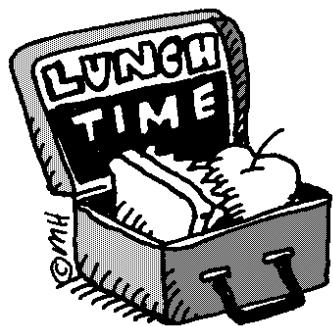
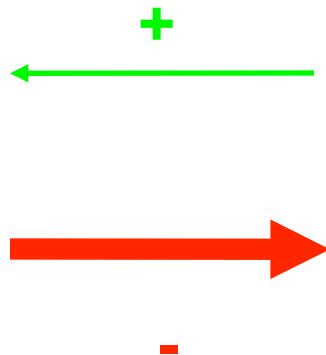


Secretary bird
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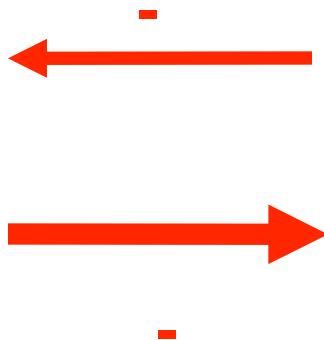
Striped Skink
Mabuya striata



Why is predation important?



Why is predation important?



Signaling inedibility

- Problem with being toxic: you have to eat me to find out
- Poisonous herps usually have warning signals that they send to potential predators
- **Aposematic coloration** = bright colors that warn of toxicity



D. auratus 'Blue'

© 2001 Arachnokult



D. auratus 'Hawaiian'

© 2001 Arachnokult



Poison dart frogs
(*Dendrobates*)

Herps and stability

- Herps affect food webs in three ways
 - Omnivory: increase connectedness
 - Energy efficient: increase food chain length
 - Complex life cycles: link different food chains